Medicine and the Naturalist Tradition

J.C. Valmont de Bomare, *Dictionnaire Raisonné Universel d'Histoire Naturelle*, 1791.

U.S. Department of Health & Human Services • Public Health Service • National Institutes of Health

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PREFACE

For over twenty-five centuries of recorded knowledge, natural history and medicine have shared an interesting, complex and varied relationship. That relationship is explored in this brochure and its accompanying exhibition, mounted at the National Library of Medicine (NLM) in 1989. The exhibition displays over fifty works covering the period from 350 B.C. to 1989. The items are selected for their natural history interest, to suggest the scope of natural history literature in a medical collection. This brochure is intended as a supplement to the exhibition, to cover areas of medical and natural interest which could not be covered in the exhibition.

The exhibition is arranged in four groupings; within each division, the books are arranged chronologically. Three cases contain books about botany, two contain books about zoology, and two contain books about the earth sciences. Each item in these subject groupings has a medical connection. In addition, two cases of books are displayed showing works with no direct medical connection. These works, many of them seminal in the field of natural history, are collected by the NLM as support material for medical scholarship. They are included to suggest the range of natural history influences on medicine.

The natural history content of the books varies as does the directness of the medical connection. Some of the books were written primarily as natural history; others were written as medical texts, but serve as resource material for nature study. The medical connection in the majority of the books has to do with the author. Some authors were practicing physicians who wrote books containing significant amounts of nature description. Some received medical training but devoted their lives to natural history. More interesting and unusual are the authors who made careers in both fields. In this exhibition, Carolus Linnaeus, Edward Jenner, and Joseph Leidy stand out as people accomplished in both disciplines. Other authors, largely or entirely untrained in medicine, made a contribution in some way to the field of medicine through their study of life sciences.

In other items, especially texts written through the sixteenth century and those of our own century, the medical connection is found in the subject matter of the book. In these, the work was generally written for medical purposes, but the information contained within is valuable source material for naturalists. Medical botanies are the most common of this genre of medico-natural literature.

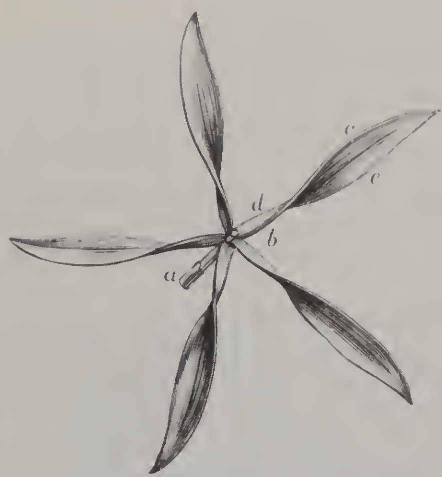
These books are offered more to astonish and intrigue than to explain or convince. An exhibition of this size cannot elucidate in any detail the relationship between natural history and medicine. However, it is hoped that the titles displayed will impress the viewer with the range of naturalist studies in which persons with medical inclinations have engaged and will provoke inquiry into a relationship which is as obvious as it is unexplored.

Each of the books displayed is, of course, but one of many of its type in the collections of the NLM. Each item can only hint at the vast amount of work being carried out by others from the ranks of medicine. For example, the exhibition does not include the botanical work of Hieronymous Bock, Leonhart Fuchs, Asa Gray, Jacob Mathias Schleiden, or William Turner. Nor does space permit the display of the zoological works of Ulisse Aldrovandi, Bartholomaeus Anglicus, Marston Bates, Elliott Coues, Antoni van Leeuwenhoek, Theodor Schwann, or Lewis Thomas. And in earth sciences, the exhibition unfortunately excludes books by Georges Cuvier, Alexander von Humboldt, James Hutton, Jean Baptiste Lamarck, Nicolaus Steno, and Abraham Gottlob Werner, as well as the many other people who act as a link between natural history and medicine. Some of this abundant literature is discussed or illustrated in the following pages.

Many people have had a hand in preparing the exhibition and this brochure. Thanks are extended to the staff of the History of Medicine Division and the staff of the Public Services Division of the NLM. Leslie Overstreet of the Special Collections Branch, Smithsonian Institution Libraries, provided invaluable assistance in selecting and arranging the illustrations on the following pages. The Lister Hill Graphics staff produced artwork connected with the exhibition and assisted in design and production of this brochure. Thanks are due also to Dr. Dale C. Smith for editorial assistance.

All illustrations in this brochure and all items in the exhibition are from the collections of the NLM, with the exception of the physicians' bookplates kindly lent by William Helfand from his personal collection.

PLATE



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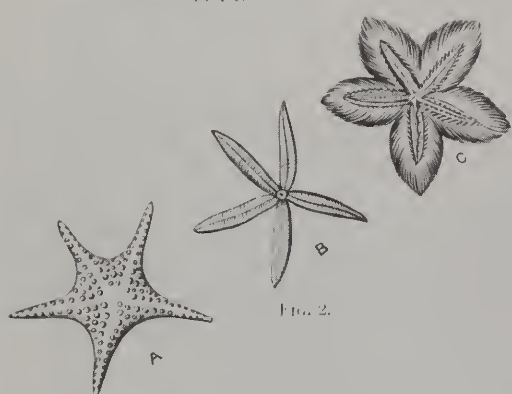

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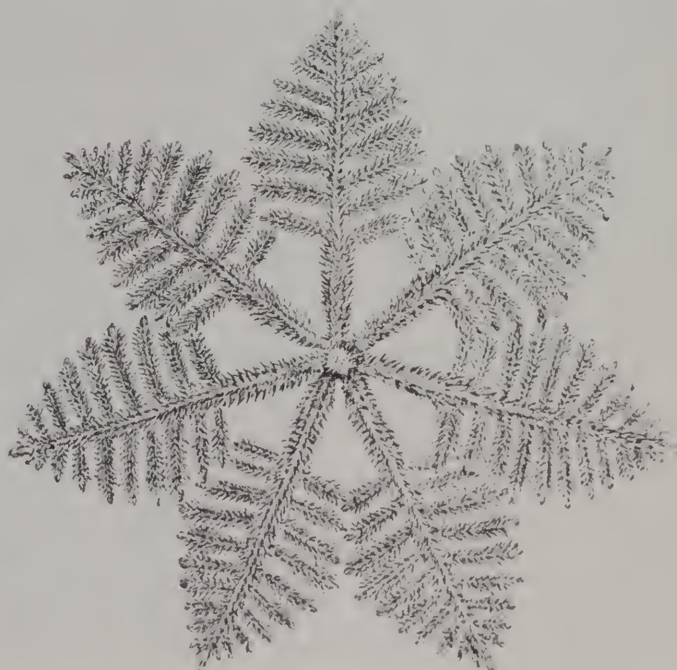


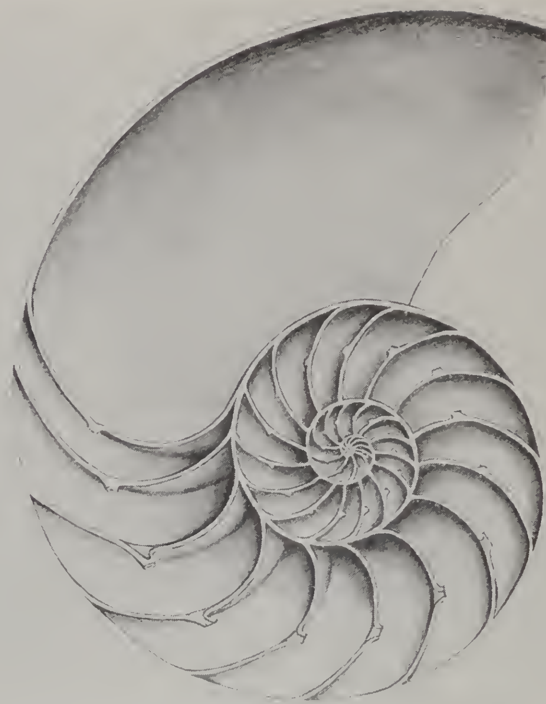
Fig. 5.

Fascination with and appreciation of objects of nature, especially animals and plants, has been an integral component of human culture at least since the time when the prehistoric inhabitants of Lascaux, France, painted animals on cave walls. The earliest surviving intelligible records of nature study date from ancient Greece. Over the course of the 2,500 years since those observations were recorded, the history, or telling, of nature has differed in form, content and purpose to such an extent that it is difficult to arrive at a definition which accounts for the variety of ideas and activities which comprise natural history in its fullest expression.

"There are few people of education who have not a pretty accurate idea of what is meant by the terms *astronomy*, or *chemistry*; but there are not many among us, who have a satisfactory idea of the term *natural history*." The opening lines of the preface to physician Benjamin Waterhouse's *The Botanist** are as accurate today as a summary of the general understanding and appreciation of the discipline of natural history as when they were written in 1811.

The study of nature diverged into the two main streams of natural history and natural philosophy in the seventeenth century. At that time natural history was defined as a concern with observing and describing, while natural philosophy attempted to explain causes. Since that time, however, historians have had little success defining natural history, stymied by a discipline whose conduct ranges between the extremes of curious amateur observation and directed professional investigation. The relatively few definitions found in the primary and secondary literature vary greatly from a narrow perception of natural history as concerning only animals and plants in their whole physical form, to a much broader concept of natural history as the study of all things of nature at almost any level of inquiry.

The entry for 'natural history' in the *Oxford English Dictionary* represents the restrictive view of the subject. The OED gives as the first definition "a work dealing with the properties of natural objects . . . a scientific account of any subject written on similar lines." In other words, natural history is defined as a book. OED definition three, "originally, the systematic study of all natural objects . . . now restricted to the



Branching formations in plants and animals (opposite) and internal spiral of a Nautilus (above). From J. B. Pettigrew, *Design in Nature*, 1908.

**All titles marked with an asterisk are held in the collections of the NLM.*

study of animal life, and freq. implying popular rather than a strictly scientific treatment of the subject," underscores the common misperception of natural history as simply a forerunner to more specialized sciences, particularly biology. This limited viewpoint is evident in such works as *World Natural History** (1937). The title suggests a comprehensive treatment, but the book deals only with animals, and in a cursory manner at that.

*Recent Publications in Natural History**, a bibliography published by the American Museum of Natural History, represents the broader view. It lists the common categories of botany, entomology, ornithology and the like, but also includes among its subject categories anatomy and ultrastructure,anthropology and archaeology, ecology and conservation, embryology and genetics, ethology, evolution, physiology and biochemistry, scientific techniques (e.g., tree-ring dating, calibration), and even mathematics and statistics. The books cited in this bibliography are restricted to those with natural history subjects, but the range of categories implies a sweeping approach to the investigation of the natural world, one that is broad and critical at the same time. Works such as *The Fundus Oculi of Birds Especially as Viewed by the Ophthalmoscope** (1917) and *Zoogeography and Ecology of Some Macro-Invertebrates, Particularly Mollusks, in the Gulf of California** (1963) are examples of scholarly literature representing this broader understanding of natural history.

Ironically, the lack of consensus on a definition of natural history belies a rich abundance of nature studies encompassing excellent endeavors in science, literature and art. Indeed, because natural history has encompassed so many endeavors, an estimate of its character is perhaps more easily gained by discussing the activities, rather than the methodologies or philosophies, involved in its pursuit.

Essentially, natural history consists of the study of natural objects by means of collecting, preserving, drawing, describing, and identifying. The consequences of these activities are the fruits of natural history by which we study its development, progress and historical significance. Collecting, preserving, drawing, describing, and identifying as activities produce expeditions, museums, illustrations, texts and classification systems as tangible results. It is in these concrete expressions of nature study that the human fascination with nature becomes evident.

EXPEDITIONS

Expeditions are evidence of an infectious curiosity, a key stimulus in the pursuit of natural history. Natural history is often the work of wanderers and adventurers, people who chronicle the features of newly discovered lands, looking as far as the eye can see to discover a new species, a new form of life which tantalizes the senses.

A bat and a gecko. From G.L.L. Buffon, *Histoire Naturelle*, 1749-1804.

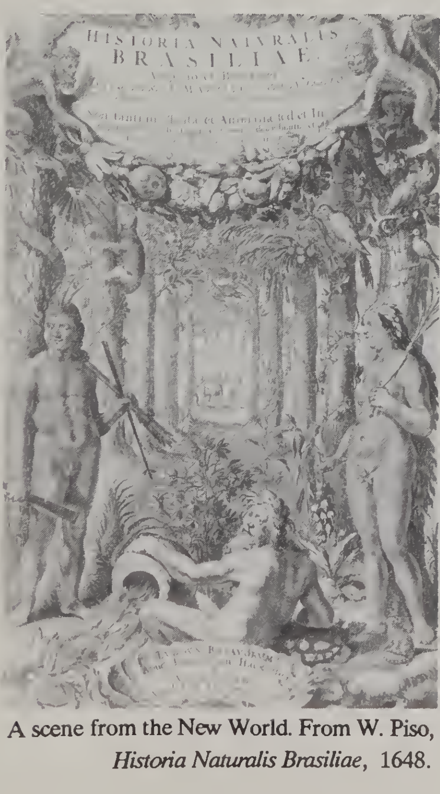
Travels and voyages for systematic exploration of the world began in earnest in the fourteenth century. The published accounts of these expeditions included valuable natural history information. Later expeditions routinely engaged the services of a naturalist who described the wildlife encountered on the voyage, in many cases with important published results. Such is the case with Charles Darwin, who accompanied the expedition circumnavigating the globe in *H.M.S. Beagle*. How long would it have taken Darwin to develop a theory of natural selection had he not travelled to the Galápagos and observed speciation in the finches now named for him? Could Darwin have formulated a universal theory without benefit of his travel experiences and by working only within a limited and familiar territory?

Similarly, the travel journals and exploration accounts of Lewis and Clark, William Bartram, John James Audubon, John Muir and selected physicians in the Medical Corp of the United States Army are critical documents for studying the natural history of North America. Remote regions and their exotic flora and fauna remain to be explored even today. The authors of *The Mosquitoes of Arabia** (1956) and *Bats of Sudan** (1975) are no less intrepid in investigating the fauna of distant, foreign lands than was Willem Piso, as judged by his 1648 account of an expedition to South America, *Historia Naturalis Brasiliae**.

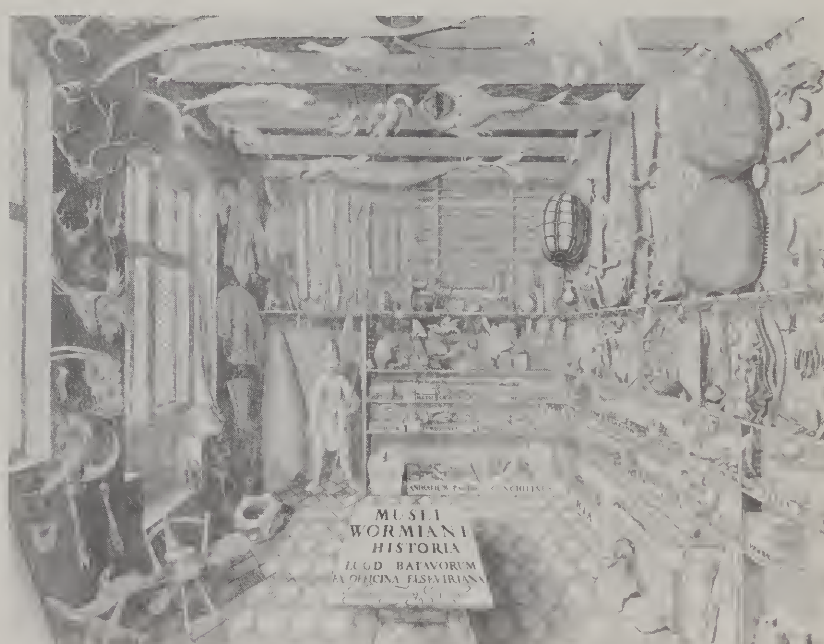
Photographic print of Castle Rock in California. From F. Hayden, *Sun Pictures of Rocky Mountain Scenery, With a Description of the Geographical and Geological Features, and Some Account of the Resources of the Great West*, 1870.

MUSEUMS

The species collected on naturalists' rounds, whether local or distant, needed to be preserved to be of later use. Museums were built, often by governments and kings, to house an always-increasing number of specimens. Georges Louis Leclerc Buffon's *Histoire Naturelle** (1749-1804) ran to 44 volumes describing



A scene from the New World. From W. Piso, *Historia Naturalis Brasiliae*, 1648.



A private collection of natural history specimens. From O. Worm, *Museum Wormianum*, 1655.

the contents of the Jardin du Roi, the largest natural history collection in Europe in the eighteenth century. Private collections contained in natural history cabinets were also popular and were important sources for natural history study.

ILLUSTRATIONS

To augment their specimen collections, it was common for naturalists to make drawings which could be used for reference and study, and for publication. Often, illustrations were made in the field. The sketches and paintings made by the naturalist were worked into woodcuts, engravings, etchings and lithographs by a skilled artist. They were useful as documentation for species not collected and, as in geology, for capturing visual descriptions of things which are impossible to collect. Images of seascapes, islands, coastlines and mountains fill the published accounts (1773-1782) of the explorations of Captain James Cook, for which no less a luminary than Sir Joseph Banks served as the expedition naturalist.

Just as often, illustrations were prepared from specimens after naturalists returned from a field trip. The acclaimed bird illustrators John and Elizabeth Gould prepared all of their plates in their studio from specimens sent from far and wide. The stiff postures, vacant eyes, and unlikely stances, or shrivelled roots and drooping leaves, seen in natural history books through the eighteenth century are evidence of illustrations prepared from dead specimens.

Illustrations emphasize the observational thrust of nature studies and are a considerable supplement to textual descriptions. In the most lavish productions, the books become as natural history cabinets displaying collections of specimens. This is especially true for the magnificent folio-sized volumes of the nineteenth century. These books are characterized by full color plates with little accompanying text, the illustrations themselves standing for the description of the species.

An onion. From W. Turner, *The First and Seconde Partes of the Herbal of William Turner*, 1568.

Wild hops. From H. Sloane, *A Voyage to the Islands of Madera, Barbados ... and Jamaica*, 1707-1725.

Title page and frontispiece of a typical natural history publication of the 18th century. From J. Ellis, *An Essay Towards a Natural History of the Corallines*, 1755.

TEXTS

The business of naturalizing in the field, collecting specimens, and taking notes of observations frequently resulted in the production of a text, which could be shared with fellow naturalists more readily than specimens. Indeed, many naturalists are known largely by identification with specific publications. John James Audubon surely always will be identified first with his *Birds of America* (1827-1838) and Dian Fossey is known today from her book about *Gorillas in the Mist** (1983) describing her conservation work in Africa.

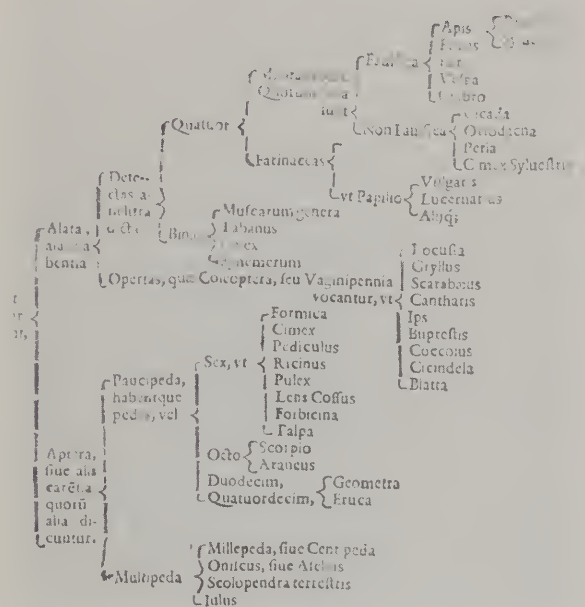
Often field work culminates simply in field notebooks or manuscript catalogs of specimens. Just as often, though, descriptions take the form of published works. Scientific periodicals, some devoted exclusively to natural history, have published naturalists' studies since the seventeenth century. The *Transactions of the Royal Society of Edinburgh** as the *Journal of Entomology*, and the *Transactions of the Linnaean Society** as *Audubon Magazine* provide a forum suitable to the publication of many nature studies. Monographs are appropriate for more extensive texts, especially when illustrations are involved.

CLASSIFICATION

Once a species had been described, it was necessary to classify it and give it a distinguishing name. The arduous task of identifying and naming species, which has belonged traditionally to the naturalist's profession, led to the development of systematics and taxonomy. Over the centuries, the basis for classification has changed many times. Species have been grouped variously according to shape, behavior, color, habitat, structure or economic or medicinal value. Today, species are classified by their affinity with other species and are given a unique place in a hierarchical structure of the traditional three kingdoms of nature (animal, plant and mineral), and their increasingly specific subdivisions (phylum, class, order, family, genus, species).

Names can be descriptive (Three-lined ground squirrel), honorific (Audubon's shearwater), onomotopaeic (chickadee), or useful (Poison hemlock). They can exist in colloquial, standardized and scientific versions; Water witch, Horned grebe, and *Podiceps auritus* all refer to the same animal. The success of any classification system intended for universal application in a scientific framework depends on its flexibility, as new species are found, existing species are reclassified, and geographical variations within species (i.e., sub-species) are recognized.

Distinguishing natural history as a discipline of observation and description and one encompassing the activities described above reveals its fundamental viewpoint: it is primarily concerned with the whole organism and so, generally, though not exclusively, looks at nature from the outside (as opposed to biology which attempts to understand nature from the inside). Hence, natural history is more often conducted in the field than in the laboratory. Additionally, it describes the relationships between species and between species and their environments, and, if a goal may be ascribed to a discipline of description, then the major objective of natural history is to account for the diversity of nature.



Branches of an early taxonomic tree classifying insects
From U. Aldrovandi, *De Animalibus Insectis*, 1638

Botanists identifying specimens. From P. Nylandt, *De Nederlandse Herbarius of Kruydt-boeck*, 1682.

Natural History Through the Sixteenth Century

Naturalists (likely intended to be Aristotle, Isidore of Seville and Bartholomaeus Anglicus) discuss quadrupeds. From *Hortus Sanitatus*, 1491.

A striving to account for diversity is evident in natural history literature from the beginning. Detailed descriptions of natural life revealing a fascination with the many forms of nature are prevalent in the literature of ancient Greece. Several works of considerable merit cataloging the plant, animal and mineral objects of the Mediterranean regions form the starting point for all subsequent nature studies. Chief among these are Aristotle's *Historia Animalium** (ca. 350 B.C.), Theophrastus's *De Historia Plantarum** and *De Causis Plantarum** (ca. 325 B.C.), and Strabo's *Geographica** (ca. 7 B.C.). The value of the information contained in these works is considerable. The Greeks approached their subjects rationally, even by modern standards, and based their descriptions on direct observations. Aristotle's work in particular, representing the first, and for a long time the last, records indicating appreciation of nature for its own sake, is important today for the value of its biological investigations.

The Roman historian Pliny recapitulated the classical knowledge in his *Naturalis historia** (ca. 70), rescuing a vast amount of material, both good and bad, from oblivion. It was popular and widely copied and was the primary source of natural history information through the Middle Ages.

The political and social turmoil accompanying the decline of Roman society brought to an end the free-ranging investigations which had characterized ancient natural history. For a variety of intellectual and social reasons, contributions to natural history diminished in this period. For the 1,000 years of the Middle Ages, the classical natural history corpus was codified, simplified, and reduced. The original Greek texts arrived in western Europe in Latin translation after a complex transmission through the Arabic world where the content was further altered. Statements which did not match other passages in the same work, or which did not match the medieval naturalist's own experience or beliefs were "fixed." Moreover, repeated copying and translating introduced numerous errors.

Works on nature produced in the Middle Ages were mainly of three kinds: herbals, bestiaries, and encyclopedias. Herbals dated back to the *De Materia Medica** (ca. 60 A.D.) of Dioscorides, and their object was purely medical. Bestiaries, derived from an anonymous

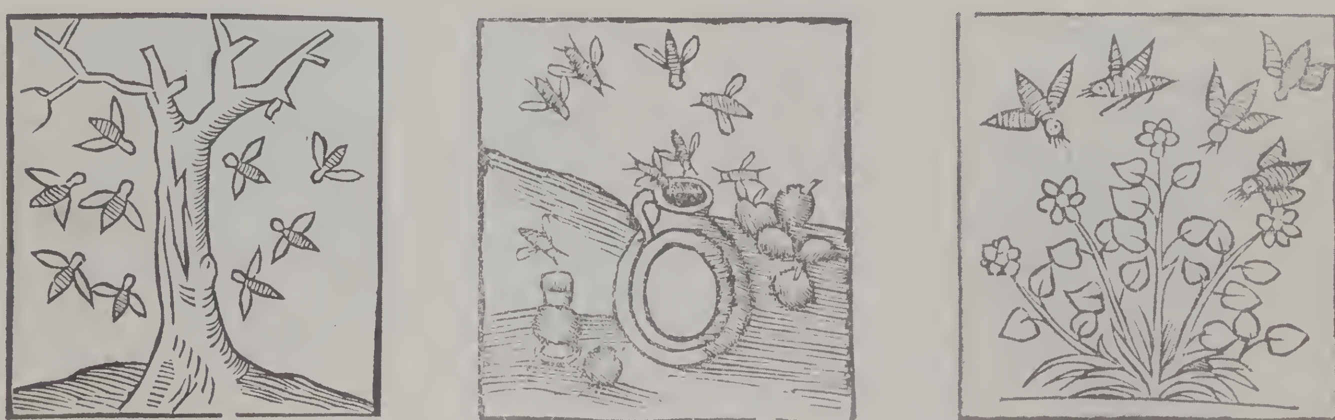
compilation known as the *Physiologus** and dating perhaps as early as the second century, gave accounts of animals, including fabulous creatures borrowed from legend and myth. Medieval naturalists also compiled encyclopedias of the world, intended to present a systematically organized account of the whole of creation. Alexander Neckham's *De Naturis Rerum*, (ca. 1200) and Bartholomaeus Anglicus's *De Proprietatibus Rerum** (ca. 1240) were two of the most important medieval encyclopedias.

All of these were derived from the body of knowledge first enunciated by the ancient Greeks. Yet the Middle Ages, like every era, had its own brand of natural history. Medieval writers of natural history were concerned with revealing God's hand at work in the natural world. Hence, they described the essential qualities of the forms of nature and portrayed their theological and moral significance. They seldom encouraged analytical investigation and were little concerned with distinguishing between factual details based on original observation and imaginary accounts from standard formulaic descriptions. Producing these works was as much a literary as a scientific or religious exercise and older texts were often copied freely without regard for scientific accuracy or verification. The illustrations found in these works provided a visual image of the symbol presented in the text. Not surprisingly, they are schematic and show species only vaguely recognizable to modern eyes.

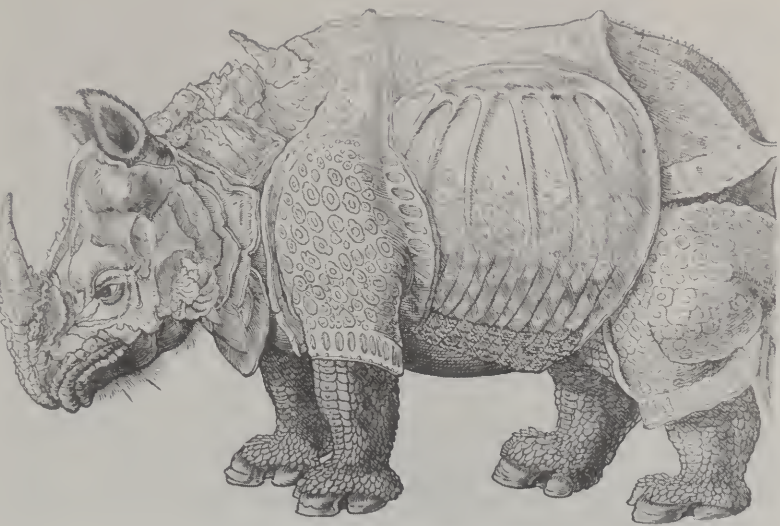
Thus, the recorded knowledge inherited by the early sixteenth-century naturalists consisted of the ancient writings, much of the scientific content of which had been diluted, corrupted or simply lost over 2,000 years of transmission and translation, mixed with the medieval writings which replaced empirical investigation with moral didacticism.

The Renaissance instilled a renewed interest in the writings of antiquity and reinstated observation as a critical element of nature studies by once again making available the writings of Aristotle in original Greek texts. In short time, sixteenth-century humanists objected to the medieval treatment of natural history and worked to re-establish the authority of classical authors and their empirical approach to nature.

At the same time that humanism opened the eyes of naturalists to the nature of the past, it also opened their eyes to the nature of the present. An increased



Although 15th-century naturalists recognized the differences between animals, woodcut illustrations did not always distinguish the different forms, as with the wasps, flies, and butterflies shown here. From *Hortus Sanitatus*, 1491.



A rhinoceros, adapted from a woodcut originally by A. Dürer, and a godwit. From C. Gessner, *Historiae Animalium*, 1551-1587.

interest in local species resulted when naturalists collated classical texts. When Renaissance naturalists tried to verify Aristotle's descriptions of Mediterranean species with the ones growing or living in their own yards in France or Germany, they began to recognize the variety of life not accounted for in classical texts. Voyages and travels to explore the world and bring its riches home to Europe confirmed that much existed in nature for which Aristotle had not accounted. The amount of information about nature grew steadily and became firmly rooted once again in personal observation.

Developments in printing technology in the fifteenth century and the increasing use of data based on observation in the sixteenth century led to improvements in the illustration of natural history books. Greater numbers of illustrations appeared to assist in distinguishing among the new forms of life being examined. The skillful woodcuts of later sixteenth-century books were also larger in size and sharper in detail than illustrations appearing in earlier books, revealing the closer scrutiny with which naturalists approached nature. Moreover, they were the first to depict individual species in a recognizably modern form; in earlier books, a single illustration often stood to represent more than one species. These illustrations became an increasingly important adjunct to the text as pictures could be used to improve upon and expand the verbal description.

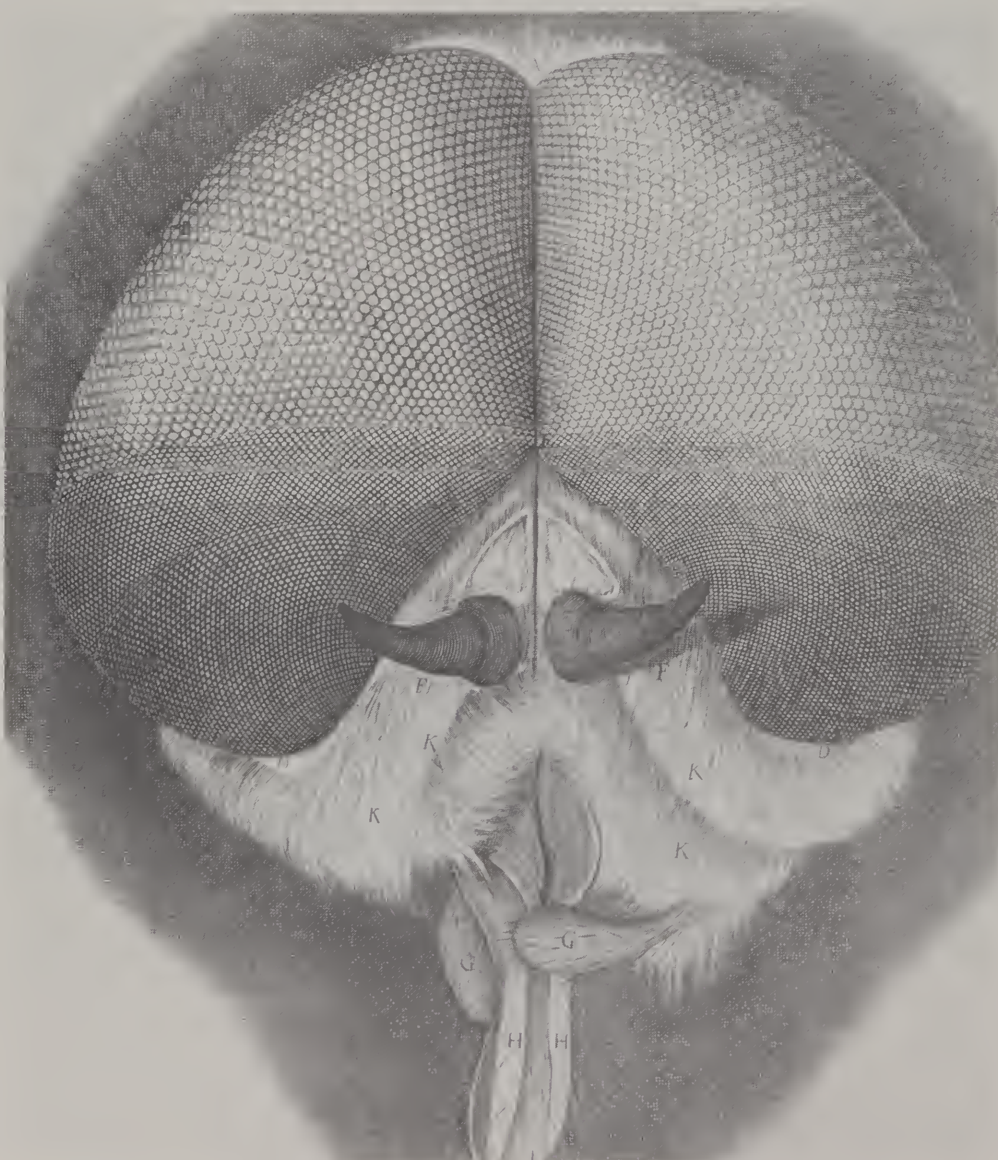
The splendid woodcuts in Conrad Gessner's *Historiae Animalium** (1555-1587) are exemplary of sixteenth-century natural history illustration. The 2,000 individual cuts are remarkably accurate and skillful and many were copied by other artists for nearly 200 years. The influence of the master woodcutter Albrecht Dürer revolutionized botanical illustration in the same way that Gessner's woodcuts improved zoological illustration. Dürer trained his students in the precise observation of plants in the field, a technique which he in turn carried into his own woodcuts.

Natural History in the Seventeenth and Eighteenth Centuries

From Gessner onward, steady growth in the inventory-taking of nature was evident in the increasing number of publications dealing with objects of nature. Natural history attained a remarkable breadth in the seventeenth and eighteenth centuries and extended the reaches of the traditional categories of plants, animals and minerals. At the same time, specialized sciences emerged from the more general studies of botany, zoology and geology, adding new categories of nature research and adding depth to natural history's broad field of inquiry.

Experimental research involving quantifiable data was applied to botany and zoology in this period. Specialization also received stimulus from the improvement of the microscope in the mid-seventeenth century. This instrument gave naturalists a more penetrating view of nature, enabling entomologists, for example, to conduct controlled experiments proving that worms and flies were not spontaneously generated out of decaying meat. Robert Hooke's *Micrographia** (1665) includes exceedingly delicate and detailed illustrations of magnified insects.

The discovery of previously invisible spheres of life



Microscopic view of the head of a fly. From R. Hooke, *Micrographia*, 1665.

Adam and Eve naming creation. From J.C. Valmont de Bomare, *Dictionnaire Raisonné Universel d'Histoire Naturelle*, 1775.

helped to redirect the course of natural history. At the turn of the century, a work such as Ulisse Aldrovandi's *Historia Naturalis** (1599-1623), an extensive five-volume encyclopedia of natural life, was typical. But the fashion for encyclopedias faded as naturalists began to concentrate their studies on smaller divisions of subject matter. By the middle of the century, works such as Francesco Redi's *Esperienze Intorno alla Generazione degl'Insetti** (1668), reflecting specialized work in such distinct fields as anatomy and physiology, became a regular part of the literature of natural history.

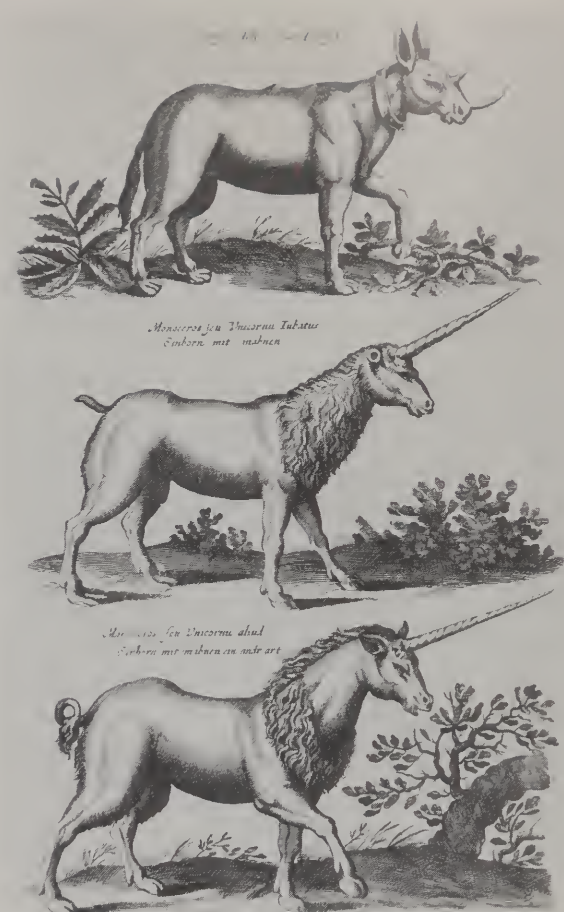
At this time, naturalists interpreted diversity as an expression of divine power. John Ray, for example, one of the preeminent naturalists of all time, counted among his publications *The Wisdom of God Manifested in the Works of the Creation** (1722). In particular, geologists viewed the existence and distribution of fossils in terms of diluvialism. This theory explained that fossils were remnants of species which had not survived the great biblical flood (other more recent floods were also suggested), and that since the deluge, species had remained fixed in time. By the end of the century,

however, the number of publications in geology had greatly increased. Following upon the pioneering work of Nicolaus Steno, geologists began to recognize the similarities between particular fossils and living animals. Belief in a universal flood began to fade and various theories of evolution appeared as an explanation for diversity.

Certain age-old myths, lying outside the realm of empirical investigation, persisted in natural history literature well into the eighteenth century, helped along by indiscriminate compilers and borrowers such as John Jonston and Edward Topsell. By the end of the eighteenth century, however, hearsay as a system was relegated to the literature of poetry, replaced in the scientific community by increasingly analytical study.

The increased attention to detail and verification was seen in illustrations. Engraving on metal plates replaced woodcutting, the fine line of the engraving burin being able to reveal far more than a cut of the knife. Engravings had appeared in natural history works as early as Fabio Colonna's *Phytobasanos** (1592) and became the standard means of illustration by the end of the seventeenth century.

Learned societies emerged as additional evidence of specialization. They were formed to address the peculiar research needs of the different disciplines and also helped to give natural history, especially botany and zoology, a social standing and air of respectability it had not known previously. The societies further extended the influence and success of natural history by publishing journals for documenting discoveries and researches. The Royal Society of London, one of the earliest and most enduring of science societies, was formed after a group of scholars in 1645 began to meet periodically to discuss their research. In 1665 the society launched its *Philosophical Transactions** which it still publishes today.



Unicorns. From J. Jonston. *Historiae Naturalis de Quadrupedibus*, 1657.

In the mouth of a volcano. From L. Spallanzani, *Travels in the Two Sicilies*, 1798.

Accompanying the increasingly sophisticated physical studies was an improved philosophical framework for organizing the masses of information. In the scientific world at large, the seventeenth century has been called the period of great systems of thought, during which all the knowledge that the Renaissance brought to light was summarized and classified.

In natural history, the newly emerging discipline of morphology began to serve as the basis for classification. In previous centuries, naturalists had used a variety

of artificial classification schemes, ranging from alphabetical arrangement to economic utility. John Parkinson, in 1640 in his *Theatrum Botanicum**, had grouped plants as sweet-smelling, purging, venomous, sleepy and hurtful, and strange and outlandish. In the same way, the *Grete Herball** (1561) delineated mushrooms of two kinds: "one . . . is deadly and slayeth them that eateth of them" and "the other doth not."

Later naturalists objected to these artificial classification schemes based on arbitrary qualities. Although Buffon, as late as 1750, grouped animals according to their relationship to man, the tendency was towards a natural classification, that is, one based on intrinsic overall structural similarities between species, accounting for the peculiarities of the individual organism as well as its relationship to other forms of life.

The Swedish botanist-physician Linnaeus is the best-known of eighteenth-century taxonomists. His classification scheme which permitted orderly change with the constant increase in knowledge, provided a successful mechanism for one of the basic tasks of naturalists, the naming of species. Binomial nomenclature, the practice of giving each species a unique two-part name which reflects its place in the classification scheme, was introduced by Linnaeus in his *Systema Naturae** (1758, definitive tenth edition) and is still used today in zoology.

The great advances made in nature studies in the seventeenth and eighteenth centuries were due, at least in part, to the continual increase in the number of newly discovered species and forms of life. Travel accounts of voyages to the New World and other parts of the globe are common in natural history literature from this period. The accounts of distant lands received by European naturalists revealed an astounding abundance and diversity of life forms which had no equivalents in the Old World. Information about the many new species piqued curiosity and did much to enliven naturalists' studies.

Explorations of the geographical limits of natural history also resulted in a new genre of nature publishing, regional natural histories, covering the objects of nature of a particular area. At first, regional accounts were exotic and described distant lands. In 1565, Nicolas Monardes related botanical wonders from the New World in *Dos Libros . . . de Todas las Cosas que Traen de Nuestras Indias Occidentales**. Later, naturalists began

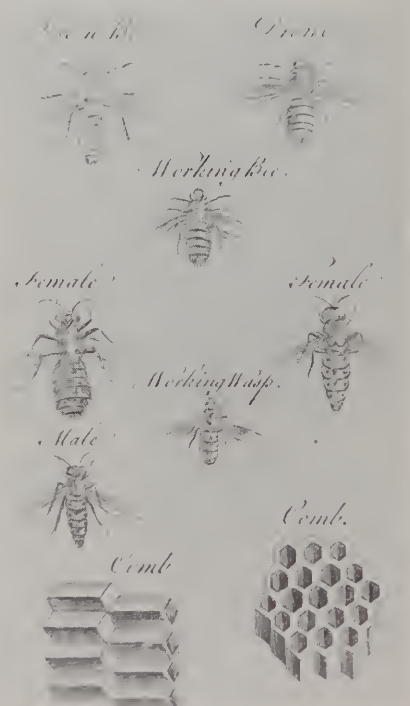
A coral. From J. Ellis, *The Natural History of Many Curious and Uncommon Zoophytes*, 1786.

to look more closely at the world nearby. Local natural histories, describing familiar territory in more detail, began to fill in the gaps of knowledge revealed by the ever-receding horizon. Robert Plot's *Natural History of Oxford-shire** (1677) and Gilbert White's famous study of *The Natural History and Antiquities of Selborne* (1789) are classic examples of the study of the flora and fauna of a particular region.

A scarab. From E. Albin, *A Natural History of English Insects*, 1720.

Through the many advances occurring in the life sciences, natural history attained a vitality independent of the other sciences on which it had rested in previous centuries. Much of the investigation of the natural world, especially plants, in previous centuries had been done in the service of medicine. Although certain branches of natural history were still conducted in the medical realm, overall it had taken on the dimensions of an independent discipline, divorced from dependence on classical authority and freed from restrictions of medical and moral service.

Striking evidence of this vitality was the new subset of naturalists, the professional painter-naturalists, who fed the growing hunger for natural history books. They glorified the beauties of nature with stunning hand-colored engravings, initiating that marvelous period of lavishly color-illustrated natural history books which lasted for some 170 years and produced some of the most well-known books of natural history literature. Eleazar Albin, through works such as his *Natural History of English Insects** (1720) is recognized as one of the earliest and most accomplished of the nature artists whose ranks included the zoological illustrators Mark Catesby and Audubon, and the flower-painter Pierre-Joseph Redouté.



Advances in zoological illustration in the 17th and 18th centuries can be seen in the woodcut and the engraving of butterflies from (left) T. Moffet, *Insectorum Sive Minimorum Animalium Theatrum*, 1634, and (center) R. Brookes, *Natural History of Insects*, 1763. In addition, Brookes demonstrates the increased understanding of the concept of species by grouping animals (right) which earlier naturalists had considered separate.

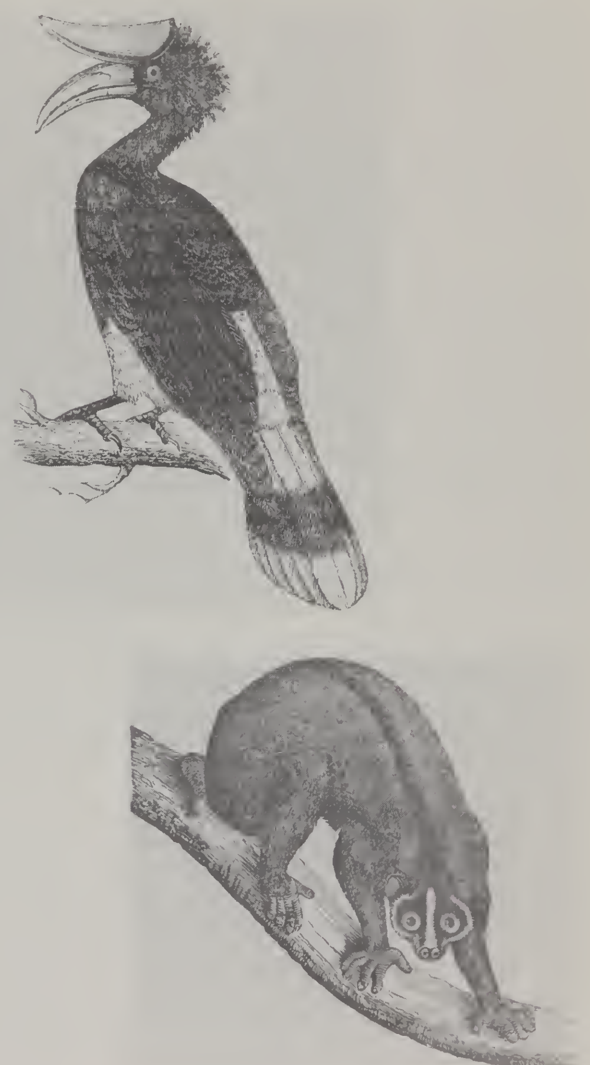
Natural history became a fruitful and prosperous occupation in the nineteenth century, attaining a magnitude of scope unapproached by the eighteenth. The thousands of species cataloged in the eighteenth century gave way to hundreds of thousands in the nineteenth, which changed the empirical base of natural history research. Institutions such as the British Museum and Smithsonian Institution amassed enormous working collections that supplanted the amateur cabinet for purposes of scientific research.

As a result, the branches of natural history became more specialized, such that nineteenth-century entomology or ornithology differed markedly from its eighteenth-century counterpart. In contrast to Buffon, who only a century earlier had accounted comprehensively for all three kingdoms of nature, a mid-nineteenth-century naturalist typically treated only a single family or even genus. Titles such as *A Monograph of the Phasianeidae* (1872) or *Guide to the Specimens of the Horse Family (Equidae) Exhibited in the Department of Zoology, British Museum (Natural History)** (1907) are common in this period.

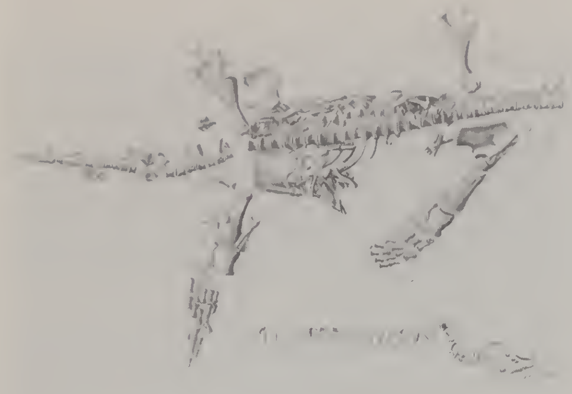
New methods of nature study also appeared, reflecting a fresh approach to nature. Guns were set aside in favor of binoculars and cameras at the end of the nineteenth century. Hence, specimen collectors had opponents in protectionists who advocated studying live animals and plants in their natural environment. Indeed, the National Audubon Society resulted from efforts to preserve birds which were being slaughtered for feathers to be used in ladies' hats, and reflected the growing popular element of nature studies. William Jardine published 40 volumes of his *Naturalist's Library* (1835-1845) aimed at this new market. The *Naturalist's Library* answered the demand for portable, affordable and popular natural history books from the growing conservation-minded public.

The craving for living nature sweeping Europe and America was evident also in the enormously popular works of the celebrated nature artists of the middle and late nineteenth century, among them John Gould, Louis Agassiz Fuertes, John Gerrard Keulemans, Edward Lear, William Lizars, Joseph Smit, and Josef Wolf. These artists achieved the finest expression of

Osteology of a grebe. From E. Coues, "The Osteology of the Colymbus Torquatus," 1866.



A hornbill and a lemur. From W. Baird, *A Dictionary of Natural History*, 1860.



Fossils *in situ*. From G. Cuvier, *Discours sur les Revolutions de la Surface du Globe*, 1825.

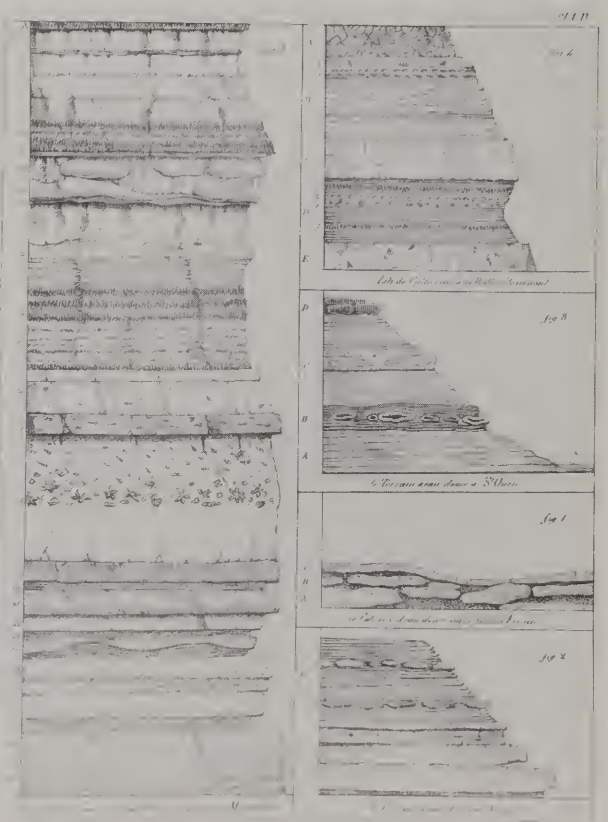
realism in printed animal illustration by utilizing lithography, a new illustration technique which involved drawing rather than cutting or engraving. The more realistic postures and behavioral displays effected through lithography suggested life and motion. By the end of the century, a wealth of vibrantly colored lithographs documented the exploding dimensions of natural history inquiry and reflected the fresh approach to nature in depicting species life-sized where possible, and set in their natural habitat.

The reorientation of nature study to focus on a vital, living nature was the result of two major and related developments in natural history. First, geology emerged in the early nineteenth century as a discrete discipline. Second, following on the advancements made in geology, Darwin published his theory of natural selection and permanently changed the course of natural history research.

The rumblings of scientific geology appeared in the mid-eighteenth century, and developed rapidly through the next fifty years. Abraham Gottlob Werner's accomplishments in mineralogy, the work of Georges Cuvier and Jean Baptiste Lamarck in paleontology, and James Hutton's theories of natural geological processes were evidence of a more sophisticated and objective view of the history of the Earth.

Geology emerged in the first years of the nineteenth century as a distinct discipline, accompanied by increasingly sophisticated studies in paleontology, glaciology, geomorphology, and tectonics. In 1807 the Geological Society of London was founded, a late-comer to the company of botanical and zoological societies which had flourished for nearly 200 years. Charles Lyell championed the importance of the subject in his *Principles of geology* (1830). This work opened a new era in geology by advancing uniformitarianism, the theory first set out by Hutton that the past record of the Earth can be explained by the geological processes of the present.

By the mid-nineteenth century, geology had acquired a radically new character, stressing paleontology and stratigraphy in their historical dimension. No longer invoking the Noachian flood to explain the history of the Earth, geologists settled on evolutionary principles to portray the history of our planet as one of continual and unbroken development from its earliest beginnings. Relying on the evidence of organic remains in the soil,

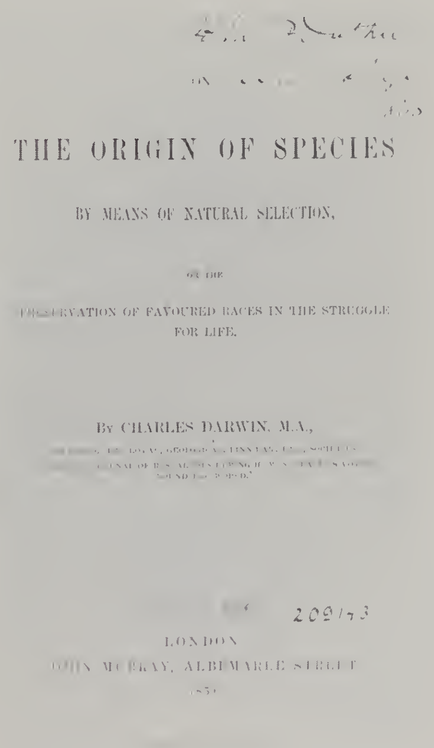


Stratigraphy of the terrain of Paris. From G. Cuvier, *Recherches sur les Ossemens Fossiles*, 1821-1824.

geologists also affirmed that the crust of the earth contained an abundant, though incomplete, record of the successive stages through which species have passed to reach their current forms and organization.

Discoveries about the origins and formation of fossils changed naturalists' understanding of the formation of the earth and the history of its inhabitants. This ground-breaking work in geology provided Darwin with a background for his theory of natural selection. By conceiving a mechanism for evolution, Darwin provided naturalists with a successful framework for grappling with the bewildering diversity of nature.

Natural selection explained that new species arose when environmental conditions favored the survival and reproduction of those individuals which possessed adaptive or advantageous variations from the existing norm. Unfavorable variations did not survive or reproduce as well, and thus gradually over many generations an entire breeding population could acquire the new characteristics. By demonstrating species mutability, Darwin's theory challenged the orthodox concept of the fixity of species.


THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

FOR LIFE.

BY CHARLES DARWIN, M.A.,

LONDON

Title page from Darwin's classic. From C. Darwin, *On the Origin of Species By Means of Natural Selection*, 1859.

Evolution of the modern horse. From *Guide to the Specimens of the Horse Family (Equidae) Exhibited in the Department of Zoology, British Museum (Natural History)*, 1907.

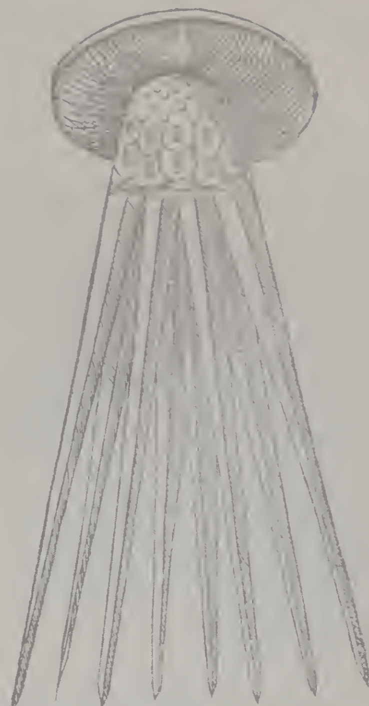
With diversity explained in terms of natural selection, the study of organisms was placed in a new light where each was viewed in the context of its natural environment. Concern for the environment resulted and was reflected in a wide variety of activities spanning the professional and amateur naturalists' communities. By 1910, feeding birds had become a national pastime in the United States, and the first banding experiments with birds were attempted at about the same time. The focus on the interrelationships between organisms and their environments came to be called ecology and became the intellectual context for the practice of natural history in the twentieth century.

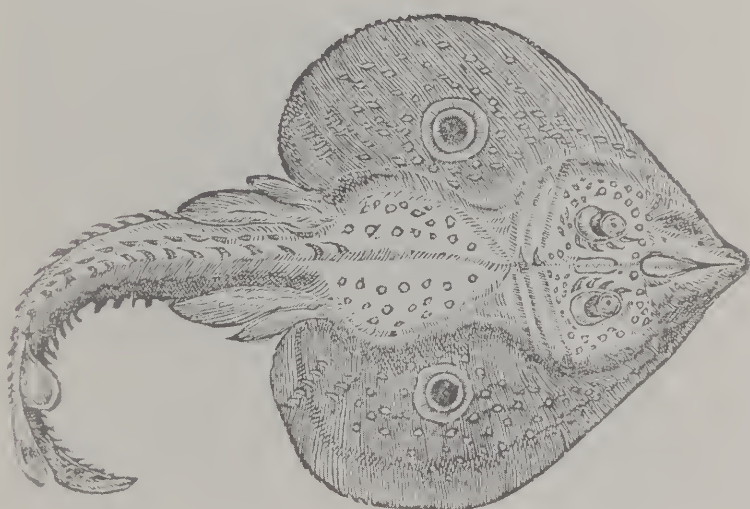
The ecological base for modern nature studies is well known in the many wildlife studies of Africa. Joy and George Adamson's studies of lions, Jane Goodall's work with primates, and Mark and Delia Owens's field research on hyenas are conducted from a philosophical framework which understands that diversity is not simply one of the great wonders of nature but is a requirement for life, since the health of an individual species, *homo sapiens* included, depends on the health of many other species.

Natural history, as the basic observation and description from which more advanced studies proceed,

is applicable to certain studies in particular; in studies of behavior and breeding, and studies of populations such as migration or whale songs, simple identification and understanding of the whole organism and its place in natural populations are critical. In the same vein, natural history has much to offer the modern earth sciences. Studies of natural resources, especially oil, clean water, and tropical rain forests, and studies of pollution must begin with geographical, geological and meteorological natural history.

In these and other manifestations of modern natural history, exploration, collecting, illustration and classification still play an important role. Entomologists estimate that perhaps as few as 25% of the world's insect species have been discovered and identified; a figure only slightly higher is offered for marine animals. It is clear that much of the world's natural life remains to be explored. Furthermore, the number of new species being recorded, the discovery of life forms which do not fit neatly in the traditional tri-partite classification scheme, and advanced work in evolutionary genetics have resulted in new ideas about species and the process of speciation.





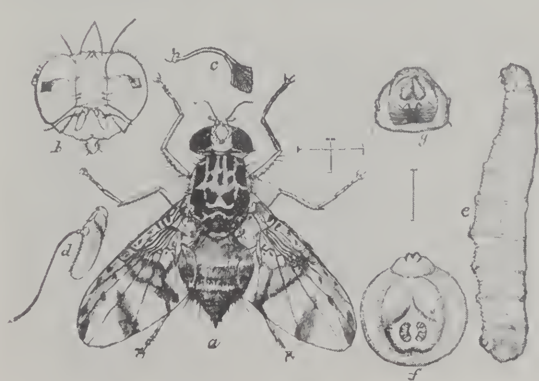
Creatures of the sea. From G. Rondelet, *Libri de Piscibus Marinis*, 1554.

Museums, zoos and biology laboratories still collect specimens in traditional ways. In addition, other forms of collecting have been devised in some fields; in birdwatching, binoculars and lists of sightings are forms of collecting paraphernalia. Illustrations are a key part of the many popular field identification guides available today and are also integral to scientific publications. The camera has joined the brush and pencil as a standard means of providing visual images of natural history. The photographic work of wildlife magazines and films relays the ecological thrust of modern natural history, and nature films constitute an important part of popular natural history 'literature.'

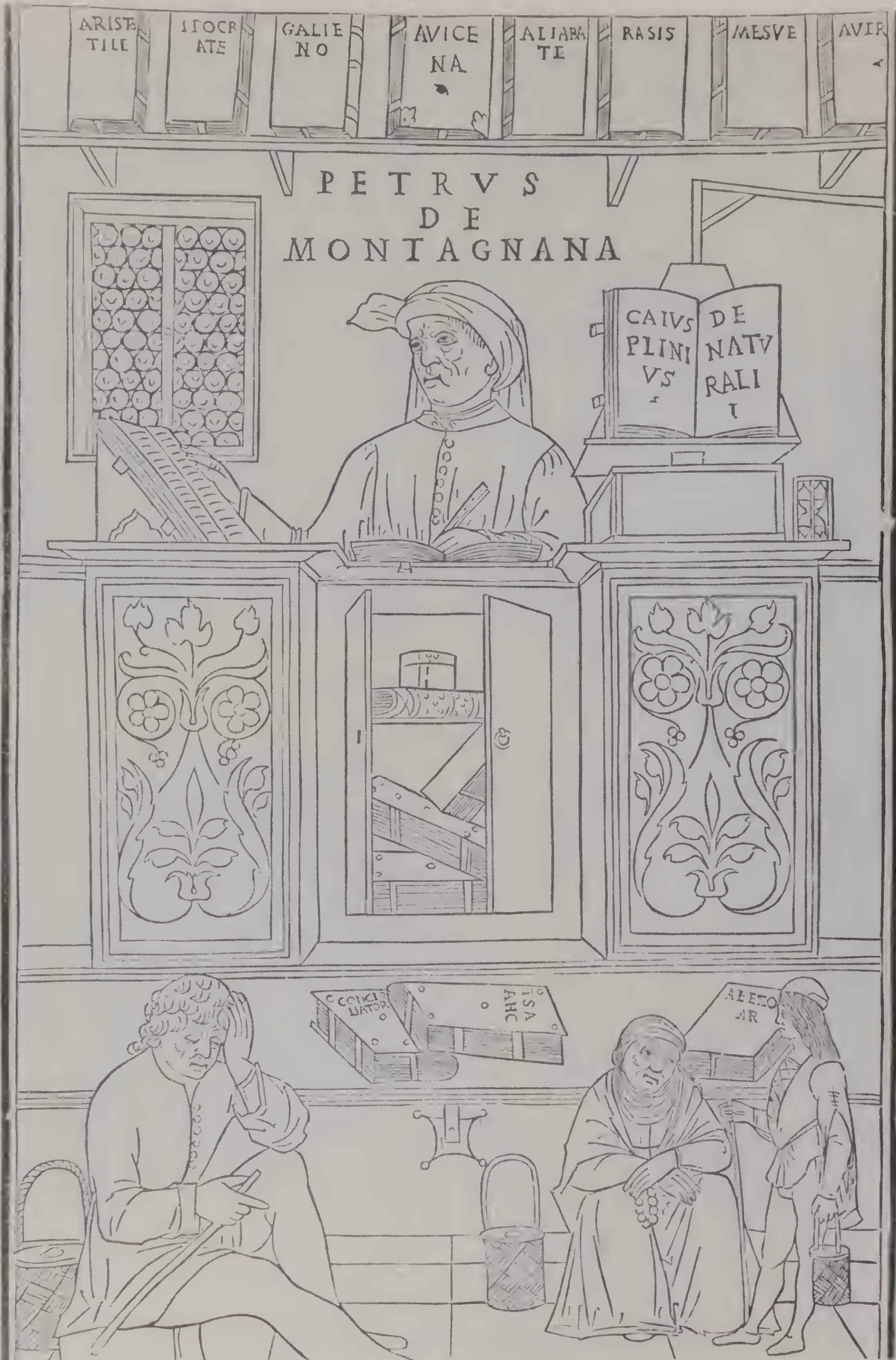
In return for the groundwork laid out by natural history, specialized sciences such as cytology, chemistry, climatology, and physiology, and even specialized technology such as aeronautics and computers, have contributed to natural history. No matter how sophisticated the technology to deal with raw data becomes, however, and how entangled natural history becomes with biology, geology and other specialized sciences, there will always remain a need for the basic work of observation and description which the naturalist tradition provides.

Over the course of many centuries, then, natural history at heart has been concerned with the description of natural objects based on observation. To summarize its philosophy or aims, however, is probably impossible, and, as one historian suggests, unnecessary. Throughout the centuries, the character of natural history has differed according to the perceived usefulness or purpose of the natural world; at times, it was informed by economy, at times by religion, and at other times by science. Benjamin Smith Barton points out in his *Discourse on the Principal Desiderata in Natural History** (1807) that it is "extremely difficult to point out the precise limits of natural history, so intimately connected is this science with many others."

It is the unique character of natural history to synthesize the various elements of nature study and present them in a formal portrait of life on Earth, which reveals the importance of natural history, as Francis Bacon claimed, as the "great root and mother" of all the sciences.



The illustrations shown here, wood engravings of a gadfly and fruitfly and a lithograph of a tse-tse fly, reveal the continuing advances being made in both illustration technique and scientific knowledge of the animal world. From W. Baird, *Dictionary of Natural History*, 1860, H.A. Ballou, *Insect Pests of the Lesser Antilles*, 1912 and E.E. Austen, *Handbook of the Tsetse-flies*, 1911.



A Renaissance physician in his library, with a copy of Pliny's *Naturalis Historia* open on the book stand.
From J.D. Ketham, *Fasciculus Medicinae*, 1495.

RELATIONSHIP BETWEEN MEDICINE AND NATURAL HISTORY

The importance of plants, animals and minerals to medicine is obvious at many levels. The relationship, however, between natural history and medicine as distinct disciplines is less obvious and extremely complex. Natural history, as the basic and initial description of any natural object or phenomenon from which more advanced study proceeds, is the "great root and mother" of medicine as well as any other science. Bacon's metaphor, which aptly reflects the particular importance of botany to medicine, recognizes that identification of a plant, for example, necessarily precedes investigation into its utility as a drug.

Where natural history leaves off and science begins, however, is not well-defined. It is clear from the variety of work carried out by modern institutions of natural history that natural history is more than simply the first episode in the narrative of the life sciences. The body of knowledge and literature recognized as properly belong-ing to natural history includes no small amount of specialized studies where naturalists venture beyond description and begin to explain what they observe. It is at this margin, where natural history borders on specialized sciences, that the importance of natural history to medicine lies.

THE UTILITY OF NATURE

Part of mankind's early preoccupation with nature stemmed no doubt from his observations that natural objects were both helpful and harmful to human health. Plants, animals and minerals may cause illness, disease and injury; at the same time they are sources of medicine and nourishment.

The ancient world, recognizing the dual character of the natural world, investigated nature almost entirely for its utility, especially its medical and agricultural uses. With few, but important exceptions such as Aristotle and Theophrastus and the German emperor, Frederick III, who wrote a decidedly modern treatise on falconry in the twelfth century, this approach lasted through the sixteenth century. Naturalizing as it would be defined today was often conducted in the course of carrying out medical studies and practice. Physician-naturalists, including Dioscorides, Gessner, Andrea Cesalpino, Monardes and William Turner, compiled books

Parasites represented as a garden. From J. Leidy, *A Flora and Fauna Within Living Animals*, 1853.

discussing the important features of plants, animals and minerals in terms of their known uses to humans, including their medical applications.

A modern version of this literature which canvasses the natural landscape with a medical eye is *Arctic Manual** (1944). This work was written as a survival manual for Arctic explorers and gives an account of the natural history of the region with sections on the physical effects of cold, sources of water and food (with a warning to avoid eating the liver of the polar bear), the use of reindeer for transportation and the preparation of animal skins for clothing.

After natural history began to take on a personality of its own in the seventeenth and eighteenth centuries, it and medicine enjoyed a more balanced relationship, benefitting from reciprocal contributions. Natural history provided the starting point for certain advanced studies in medicine, and medicine contributed specializations such as physiology and anatomy for advancing natural history.

The work of Nicolaus Steno is an important example of the contributions going back and forth between medicine and natural history in this period. Steno is regarded as the major influence on geological studies in the seventeenth century and laid down some of the fundamental axioms of stratigraphy. In his *Elementorum Myologiae Specimen** (1667) he describes the anatomy of a dog-fish. Noticing the resemblance between the teeth of this fish and fossil sharks teeth which he found in the interior of Italy, Steno radically proclaimed that the shark's teeth had been part of a living animal and their occurrence in the rock illuminated the history of the Earth. He was particularly suited to deal with the nature and origin of fossils by virtue of his medical training as an anatomist through which he had already gained a European reputation.

Of all the branches of natural history, botany has enjoyed a preeminent place in medicine since the time of the Greeks. For many reasons, not the least of which is the greater ease with which botany is studied in the field, plants were studied more thoroughly and systematically than either animals or minerals for their medical usefulness. As a result, botany as a scientific study has benefitted from the organized support of the medical profession. Medieval herbals contained relatively greater amounts of accurate botanical information than their zoological counterparts, the

Botanists collect samples from the field and discuss their uses while pharmacists prepare drugs for a physician treating a bed-ridden patient. From E. Rosslin, *Kreuterbuch*, 1540.

bestiaries. Even in the Middle Ages, botany had a practical application in medicine, while animals tended to be viewed in allegorical terms. In the early sixteenth century, important advances were made in botany by Otto Brunfels, Hieronymus Bock, Leonhart Fuchs and Valerius Cordus which were not matched in zoology until a half century later and more with the work of Pierre Belon, Ippolito Salviani and Gessner. Botany continued to advance more rapidly than zoology in the seventeenth century; the botanical work of Rudolf Jakob Camerarius, Nehemiah Grew, Marcello Malpighi, and John Ray overshadowed the zoological publications of the age. Medical botany and materia medica were a regular part of the medical curriculum through the nineteenth century and produced some of the greatest of all naturalists including Linnaeus and Herman Boerhaave (1660-1738).

Botany continues to support medicine in the twentieth century, especially pharmacology as plants are still an important source for drugs. Plants are also studied for their importance in nutrition and, as one title suggests, *The Role of Plants in Environmental Purification** (1972), for their capacity to reduce air pollution. Natural history is also important for the study of plants as pathologic agents, as in *Hayfever Plants, Their Appearance, Distribution, Time of Flowering, and Their Role in Hayfever** (1945).

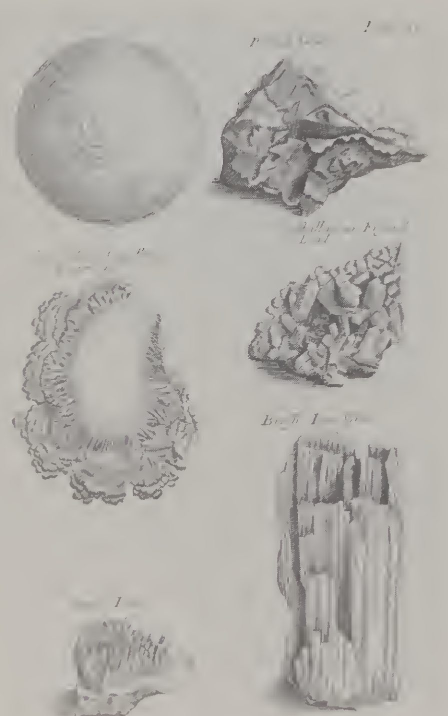
The importance of animals to medicine is different in several ways from the importance of plants. Animals are studied in part in order to learn how to deal with the injury they can cause. A discussion of shark attacks is included in *The Natural History of Sharks** (1970); *Traite sur le Venin de la Vipere** (1781) is more specific, focusing on the venom received from snake bites.

A significant portion of medico-zoological literature is devoted also to the study of animals as vectors of disease. Within this literature, studies of insects (mosquitoes, houseflies, and recently, ticks associated with Lyme disease) are especially noticeable.

Experimentation in plant physiology. From S. Hales, *Statical Essays*, 1731-1733.

Malarial (below) and non-malarial (above) mosquitoes. From R. Doane, *Insects and Disease*, 1910.

Useful animals. From P. Good, *A Materia Medica Animalia, Containing the Scientific Analysis, Natural History, and Chemical and Medical Properties and Uses of the Substances that are the Products of Beasts, Birds, Fishes, or Insects*, 1853.



Mineral specimens. From N. Grew, *Museum Regalis Societatis, or A Catalogue and Description of the Natural and Artificial Rarities Belonging to the Royal Society*, 1681.

*The Contemporary Land Mammals of Egypt** (1980), authored by medical zoologists and published by the Field Museum of Natural History, demonstrates one aspect of the relationship of ecology to modern medicine. The preface explains that this volume resulted from "a research program on the ecologic factors of arthropod-borne diseases. The necessity for accurate identification of mammalian host species and knowledge of ecologic factors and geographical distribution was of immediate importance. . . ." The project was sponsored by the Naval Medical Research and Development Command of the National Naval Medical Center, and was supported in part by a grant from the NLM.

Ecology has revealed one more aspect of the importance of plants and animals to medicine; they are useful as indexes to our own health. Publications such as *Guide for the Identification of Stranded Whales, Dolphins, and Porpoises** (1969) and *Responses of Marine Organisms to Pollutants** (1984) are further examples of the continuing importance of natural history to medicine.

Earth sciences have had a wide variety of applications to medicine, ranging from mineralogy to climatology. Georg Agricola, town physician in a mining camp, described the medical properties of minerals, stones, metals, ores and gems in his *De Re Metallica** (1561) and also studied the occupational diseases of miners. In the seventeenth and eighteenth centuries, balneology, the study of the therapeutic use of baths, gave particular emphasis to the medicinal effects of mineral springs. Titles such as *The Natural, Experimental, and Medicinal History of the Mineral Waters of Derbyshire** (1734) occupy a significant portion of medical literature.

The importance of geography and climatology are particularly important to medicine today in the study of infectious diseases, public health, and environmentally-related disease, as indicated in the title, *The Geology and Topography of Iowa in a Sanitary Point of View** (1883). Following in the tradition of Agricola, mineralogy, as studied in *Relation of Geology and Trace Elements to Nutrition** (1963), is still important.

NATURAL HISTORY IN MEDICAL SCHOOLS

Because certain areas of medicine and natural history were often inseparable investigations for many centuries and because medicine had a practical end which natural history did not possess, the formal study of natural history was aligned with medical schools well into the nineteenth century. When natural history emerged as a distinct discipline, producing a recognizable non-

medical literature of its own, the scientific training necessary for advanced study in natural history was already firmly lodged in medical schools.

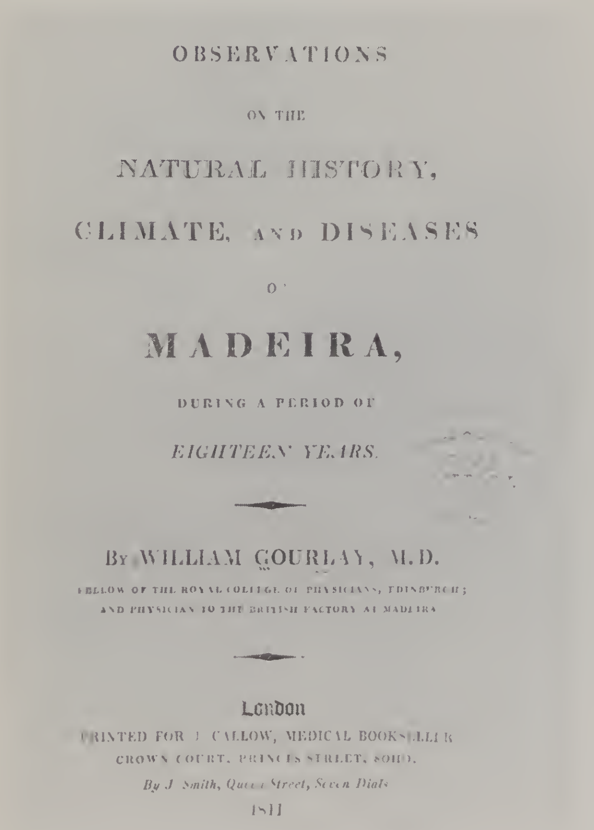
Preparation for a medical career included the study of botany as background for materia medica and the study of zoology as background for specialized work in anatomy and physiology. Although medical schools did not offer natural history as a separate subject, those wishing to study natural history in an academic setting were generally trained as physicians.

Physicians, in turn, utilized the zoological knowledge of naturalists. The study of animals was very important to medicine since natural objects were easier to collect and study than human specimens. Hence, animals served as models for human medicine. Additionally, when physicians saw the need to classify diseases in the eighteenth century it is no surprise that they turned to the principles already laid out by naturalists in botany and zoology. Nosology, the classification of disease, identified diseases as species in this period, distinguishing carefully, for example, between *typhus* and *typhoid*, and arranged the species in family, class and genus groupings.

The nineteenth century produced a great number of accomplished physician-naturalists, especially in this country. Spencer Baird, Jacob Bigelow, Elliott Coues, Asa Gray and Joseph Leidy are but a few of many who were trained in medicine and made particular contributions to botany, zoology and paleontology. Even Darwin, whose life was consumed by natural history, began his professional career by studying in the medical school at Edinburgh, where many naturalists of his day studied.

Fossil remains of an extinct armadillo from a medical museum catalog. From *Descriptive Fossil Organic Remains of Mammalia and Aves Contained and Illustrated Catalogue of the in the Museum of the Royal College of Surgeons of England*, 1845.

Certain areas of natural history remained within the medical curriculum through the nineteenth century in part because the type of training involved in medicine is the same necessary for good natural history; observing and describing, noting variance and change, and studying anatomy and morphology, all belong to both disciplines. I. R. McWhinney discusses the particular importance of observational skills in clinical medicine in "The Naturalist Tradition in General Practice" (1978) in the *Journal of Family Practice**. In the same regard, the *Flexner Report on Medical Education in the United States and Canada** (1973) emphasizes "observed facts" and states that "The human body belongs to the animal world. It is put together of tissues and organs . . . it grows, reproduces itself, decays according to general laws . . . The normal course of bodily activity is a matter of observation and experience



OBSERVATIONS

ON THE

NATURAL HISTORY,

CLIMATE, AND DISEASES

OF

MADEIRA,

DURING A PERIOD OF

EIGHTEEN YEARS.

By WILLIAM GOURLAY, M.D.

FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS, EDINBURGH; AND PHYSICIAN TO THE BRITISH FACTORY AT MADEIRA.

London

PRINTED FOR J. CALLOW, MEDICAL BOOKSELLER, CROWN COURT, PRINCES STREET, SOHO.

By J. Smith, Queen Street, Seven Dials.

1811

Title page of a medico-natural work. From W. Gourlay, *Observations on the Natural History, Climate, and Diseases of Madeira*, 1811.

. . . Scientific medicine, therefore, has its eyes open. . . ." John Ryle completes the metaphor in *The Natural History of Disease** (1936). He describes the physician as a naturalist who must study how and why humans react to disease as well as how disease progresses in the body.

Modern medicine has also begun to apply principles of evolution and ecology in recent years. Medicine has taken a new look at disease and other human afflictions in terms of the evolutionary history of humans and their place in the environment. Works such as René Dubos's *Man, Medicine, and Environment** (1968) discuss the natural world and its relevance to human biology and ecology and discuss such topics as the biomedical control of human life and disease. R.M.J. Harper's *Evolutionary Origins of Disease** (1975) goes even further in defining the evolutionary determinants and causes of human disease, focusing on health characteristics peculiar to *homo sapiens*, such as gout and pigmented moles.

MUSEUMS, ILLUSTRATIONS, AND TERMINOLOGY

The roles of museums and illustrations in medical education are further evidence that observation is a key component of medical practice. Museums are characteristic of medical institutions in the same way as natural history institutions. Both disciplines rely on repositories of specimens for accumulating evidence upon which to build further studies.

Illustration, too, has been critical to the development of each discipline. Andreas Vesalius's *De Humani Corporis Fabrica** (1593) is an artistic milestone in medicine just as Audubon's *Birds of America* is in natural history. Color is essential to the teaching of anatomy and surgery, especially in differentiating between diseased states of tissues and organs. Many of the major advances in color printing for book illustration before the mid-nineteenth century were effected in the field of medicine. Jacob Bigelow's *American Medical Botany** (1817-1821) is notable as the first American book with color-printed (as oppsed to hand-colored) illustrations. Color, of course, is important to natural history, especially botany. Some species and varieties of plants can be identified, differentiated and designated only or mainly through color.

A final similarity to consider is the terminology borrowed by medicine from natural history. Titles such

as *Field Guide to Disease** (1967) and *The Natural History of Infectious Disease** (1971) suggest that medicine owes a considerable debt to natural history.

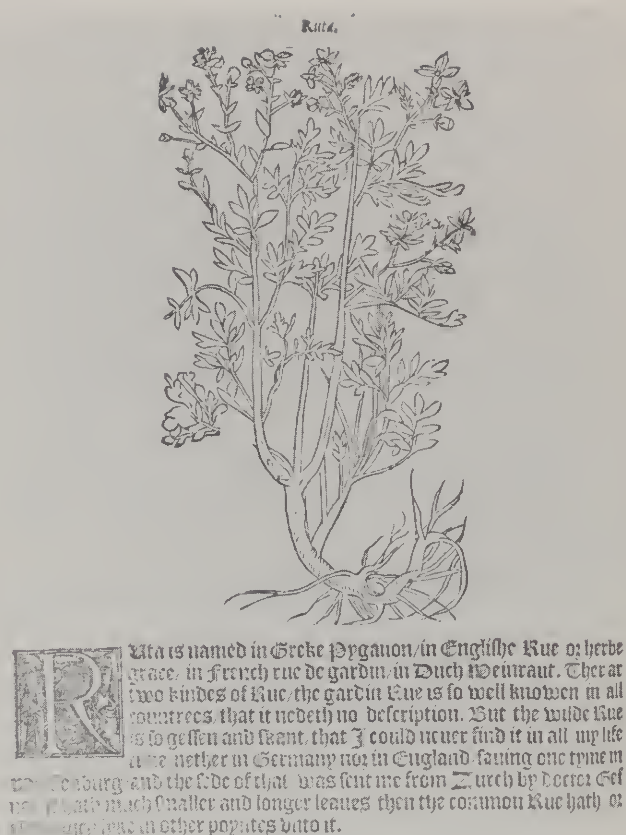
SUMMARY

An inherent relationship exists between natural history and medicine in that the natural history approach to any subject precedes the specialized scientific approach. One must first observe and describe before explaining or experimenting.

That relationship is exceptionally well presented in *A General View of the Natural History of the Atmosphere, and of its Connections with the Sciences of Medicine and Agriculture** (1808). The author presents a natural history of the atmosphere in volume one as background for his discussion in volume two of how the atmosphere and climate relate to disease. He states, "The power of the atmosphere, either as a supposed cause of diseases or as a powerful means of preventing and curing them, can only be properly determined by an examination of its properties and its affinity to other matters. In this point of view an acquaintance with the properties of the air and its influence on living bodies may seem to be particularly interesting to medical men."

But the relationship between natural history and medicine is more than sequential; it involves advanced studies on both sides where the particular interests of the two disciplines coincide.

Very few people work in both the fields of medicine and natural history in this century because of the specialization required in scientific endeavors today. The Australian immunologist and zoologist Struan K. Sutherland, who has published numerous articles and books in both fields, is a decided exception. His *Venomous Creatures of Australia, a Field Guide With Notes on First Aid** (1981) illustrates the interplay between natural history and medicine and demonstrates that the key similarities between the two disciplines are more than random overlap of two branches of the life sciences.



Ruta.

Ruta is named in Greke Pyganon/in Englishe Rue or herbe grace/ in French rue de gardin/in Duch Weinraut. Ther ar two kindes of Rue/the gardin Rue is so well knowen in all countrees/that it nedeth no description. But the wilde Rue is so geisen and skant/that I could neuer find it in all my life [illegible] nether in Germany nor in England/sauing one tyme in [illegible]burg/and the sede of that was sent me from Zurech by Doctor Ges[illegible] much smaller and longer leaues then the common Rue hath or [illegible] in other poyntes vnto it.

William Turner, a physician-naturalist, describes a plant specimen sent to him from his colleague Conrad Gessner. From W. Turner, *The First and Seconde Partes of the Herbal of William Turner*, 1568.

THE NLM COLLECTIONS

The extensive historical and modern collections of the NLM contain abundant material for studying natural history and its relationship to medicine. The variety of these materials ranges from works written by people

such as Dioscorides on the one end, who investigated animals and plants with a dual eye towards medicine and natural conditions, to the likes of Benjamin Franklin at the other end. Franklin, a man trained neither in medicine nor natural history but rather in printing and business, made scientific contributions relative to both areas through works such as *Animal Magnetism** (1837).

The numerous items of medico-natural interest also vary in the balance between natural history and medical content. There is a considerable number of works of pure natural history, such as *The Natural History of the African Elephant** (1971), with no direct connection to medicine. There are many more works written as medical texts which incorporate natural history, as in *Biomedical Applications of the Horseshoe Crab** (1979). In between are sufficient numbers of publications of varying degrees of natural or medical interest to illuminate the full implications of the relationship. The works range as well in their levels of sophistication from very general, as in *Field Natural History** (1969), to the very specialized *Manual of Forensic Entomolgy** (1986).

Natural history materials in the NLM are in several forms. Published works include periodical publications and monographs, which range from travel narratives through single subject studies to catalogs of specimen collections. Medical school dissertations, such as *Dissertatio Philosophica de Hibernaculis Hirundinum** (1671), which examines the question of whether swallows hibernate in mud during the winter, constitute a particularly interesting portion of the medico-natural materials from the collections. Manuscript and typescript field notebooks, such as *The Ornithology of Fort Reno, Indian Territory** (1890), are also relevant. Original prints and reproductions of illustrations from books, especially illustrations of medicinal plants and animal anatomy and physiology, are maintained by the Prints and Photographs section of the History of Medicine Division. Historical films also pertain to these subjects.

A serious study to explore the relationship between medicine and natural history might well begin with a single title, *Utility of Natural History, a Discourse Delivered Before the Berkshire Medical Institution, at the Organization of the Lyceum of Natural History in Pittsfield** (1823).

LIST OF ITEMS IN THE EXHIBITION

BOTANY

1. Dioscorides, fl. 50-70. *Il Dioscoride dell'Eccellente Dottor Medico M. P. Andrea Matthioli . . . coi Suoi Discorsi*. Venice : Vincenzo Valgrisi, 1548.

2. *Gart der Gesundheit*. Mainz : Peter Schoeffer, 1485.

3. Brunfels, Otto, 1488-1534. *Herbarum Vivae Eicones ad Naturae Imitationem*. Strasbourg : Joannes Schottus, 1532-1536.

4. Malpighi, Marcello, 1628-1694. *Anatome Plantarum*. London : Johannes Martyn, 1675-1679.

5. Grew, Nehemiah, 1641-1712. *The Anatomy of Plants*. London : Printed by W. Rawlins, for the author, 1682.

6. Camerarius, Rudolf Jacob, 1665-1721. *Bigam Botanicam, sc. Cervariam Nigram et Pini Conos*. Tübingen : Johannes Conradus Reisius, 1712.

7. Boerhaave, Herman, 1668-1738. *Index Plantarum, Quae in Horto Academico Lugduno-Batavo Reperiuntur*. Leiden : Cornelius Boutestein, 1710.

8. Hales, Stephen, 1677-1761. *Vegetable Staticks, or, An Account of Some Statical Experiments on the Sap in Vegetables*. London : W. and J. Innys and T. Woodward, 1727-1733.

9. Linnaeus, Carolus, 1707-1778. *Species Plantarum*. Berlin : G. C. Nauk, 1797-1825.

10. Smith, James Edward, 1759-1828. *An Introduction to Physiological and Systematical Botany*. Philadelphia : Anthony Finley, and Bradford and Read, 1814.

11. Bigelow, Jacob, 1787-1879. *American Medical Botany*. Boston : Cummings and Hilliard, 1817-1821.

12. Rafinesque, Constantine Samuel, 1783-1840. *Medical Flora, or, Manual of the Medical Botany of the United States*. Philadelphia : Atkinson & Alexander, 1828.

13. Rusby, Henry Hurd, 1855-1940. "Official Diary of the Mulford Biological Exploration of the Amazon Basin [1921]." Unpublished typescript in the History of Medicine Division, National Library of Medicine, Bethesda, Maryland.

14. Ramsbottom, John. *A Handbook of the Larger British Fungi*. London : British Museum, 1923.

15. *The Role of Plants in Environmental Purification*. Corvallis, Oregon : Environmental Health Sciences Center, University of Oregon, 1972.

16. Fuller, Thomas C. and Elizabeth McClintock. *Poisonous Plants of California*. Berkeley : University of California Press, 1986.

ZOOLOGY

17. Pliny, ca. 23-79. *Historia Naturalis*. Venice : Joannes Alvisius, 1499.

18. *Hortus Sanitatis*. Mainz : Jacob Meydenbach, 1491.

19. Gessner, Konrad, 1516-1565. *Fischbuch*. Zurich : Christopher Froschauer, 1563

20. Jonston, John, 1603-1675. *Historiae Naturalis, de Quadrupedibus Libri*. Amsterdam : Joannes Jacobus Fil. Schipper, 1657.

21. Browne, Thomas, 1605-1682. *Pseudodoxia Epidemica, or, Enquiries into Very Many Received Tenents, and Commonly Presumed Truths*. London : Edward Dod, 1646.

22. Tyson, Edward, 1650-1708. *Phocaena, or the Anatomy of a Porpess*. London : Benjamin Tooke, 1680.

23. Sloane, Hans, 1660-1753. *A Voyage to the Islands Madera, Barbados, Nieves, S. Christophers and Jamaica, with the Natural History of the Herbs and Trees, Four-footed Beasts, Fishes, Birds, Insects, Reptiles, &c.* London : Printed by B.M. for the author, 1707-1725.

24. Jenner, Edward, 1749-1823. "Observations on the Natural History of the Cuckoo." *Philosophical Transactions of the Royal Society of London*, Vol. 78(1788) 2:219-237.

25. Darwin, Charles, 1809-1882. *On the Origin of Species by Means of Natural Selection*. London : John Murray, 1859.

26. Von Frisch, Karl, 1887-1982. *The Dancing Bees*. New York : Harcourt, Brace & World, 1953.

27. Sutherland, Struan K. *Venomous Creatures of Australia, a Field Guide with Notes on First Aid*. Melbourne : Oxford University Press, 1981.

EARTH SCIENCES

28. Alfonso X, el Sabio, King of Castille, 1221-1284. *Lapidario del Rey D. Alfonso X*. Madrid : J. Blasco, 1881.

29. Agricola, Georg, 1494-1555. *De Re Metallica Libri XII*. Basel : Froben, 1561.

30. Lister, Martin, 1638-1712. *De Fontibus Medicatis Angliae*. London : Walter Kettilbus, 1684.

31. Spallanzani, Lazzaro, 1729-1799. *Viaggi alle Due Sicilie*. Pavia : Baldassari Comini, 1792.

32. Robertson, Henry. *A General View of the Natural History of the Atmosphere, and of its Connection with the Sciences of Medicine and Agriculture*. Edinburgh : W. Laing, A. Constable & Co., and W. & J. Deas, 1808.

33. Leidy, Joseph, 1823-1891. *The Extinct Mammalian Fauna of Dakota and Nebraska*. Philadelphia : Academy of Natural Sciences, 1869.

34. Dasmann, Raymond F. *Environmental Conservation*. New York : John Wiley & Sons, Inc., 1972.

SUPPORT MATERIALS

35. Aristotle, 384-322 B.C. *De Animalibus*. 13th-century manuscript in the History of Medicine Division, National Library of Medicine, Bethesda, Maryland.

36. Theophrastus, 371-287 B.C. *Aristoteles de Animalibus, in hoc Presenti Volumine . . . Habentur . . . Theophrasti De Historia Plantarum . . . De Causis Plantarum*. Venice : Octavianus Scot, 1525.

37. Ray, John, 1627-1705. *Methodus Plantarum Nova*. London : Henry Faitborne and John Kersey, 1682.

38. Albin, Eleazar, fl. 1713-1759. *A Natural History of English Insects*. London : Printed for the author, 1720.

39. Bartram, John, 1699-1777. *Observations on the Inhabitants, Climate, Soil, Rivers, Productions, Animals . . . Made by Mr. John Bartram, in His Travels from Pensilvania to Onondago, Oswego and the Lake Ontario in Canada*. London : J. Whiston and B. White, 1751.

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41. Buffon, Georges Louis Leclerc, comte de, 1707-1788. *Histoire Naturelle*. Paris : L'Imprimerie Royale, 1749-1808.

42. *Guide to the Specimens of the Horse Family (Equidae) Exhibited in the Department of Zoology, British Museum (Natural History)*. London : The Museum, 1907.

43. Carson, Rachael, 1907-1964. *Silent Spring*. Boston : Houghton Mifflin Company, 1962.

44. Leutscher, Alfred. *Field Natural History, a Guide to Ecology*. London : G. Bell and Sons, Ltd., 1969.

45. Gould, Stephen Jay. *Ever Since Darwin, Reflections in Natural History*. New York : W. W. Norton and Company, 1977.

46. Fossey, Dian. *Gorillas in the Mist*. London : Hodder and Stoughton, 1983.

47. *Natural History*. New York : American Museum of Natural History. October, 1988 and August, 1989 issues.

48. Blair, Thomas A. *Climatology, General and Regional*. New York : Prentice-Hall, 1942.

49. Gighlieri, Michael Patrick. *The Chimpanzees of Kibale Forest*. New York : Columbia Unviersity Press, 1984.

50. Fiennes, Richard and Alice. *The Natural History of the Dog*. London : Weidenfeld and Nicolson, 1968.

51. Sikes, Sylvia K. *The Natural History of the African Elephant*. London : Weidenfeld and Nicolson, 1971.

52. Elton, Charles S. *The Ecology of Invasions by Animals and Plants*. London : Methuen & Co., 1958.

53. Hardy, Alistair. *Great Waters, a Voyage of Natural History to Study Whales, Plankton and the Waters of the Southern Ocean*. New York : Harper & Row, 1967.

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Inside Back Cover Illustration: Title page illustration from T. Moffet, *Insectorum Sive Minimorum Animalium Theatrum*, 1634.

Back Cover Illustration: From C. Gessner, *Historiae Animalium*, 1551-1587.

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INSECTORVM
SIVE
Minimorum Animalium
THEATRVM:

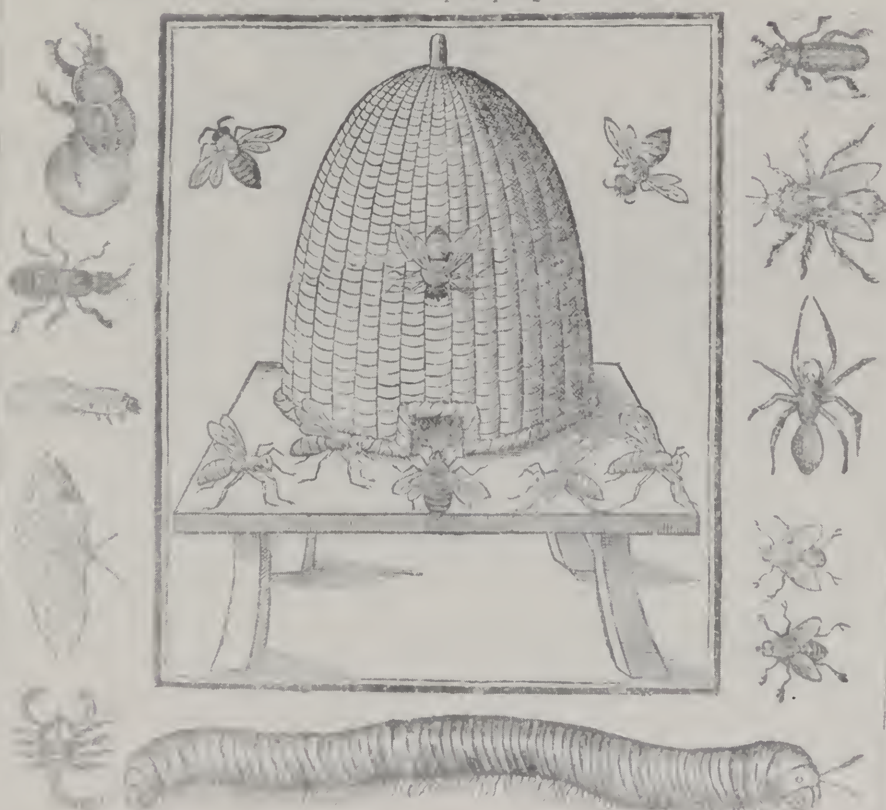
Olim ab

EDOARDO WOTTONO.
CONRADO GESNERO.
THOMAQVE PENNIO

inchoatum:

Tandem
Tho. Moufeti Londinâtis operâ sumptibusq; maximis concinnatum,
auctum, perfectum:

Et ad vivum expressis Iconibus supra quingentis illustratum.



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